

A Comparative Study of Two Different Approaches in Teaching Thermodynamics

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Abstract

A preliminary study has been carried out to compare the outcome of two different approaches in teaching thermodynamics. The results from the first year undergraduate students taking the subject for the first time in two classes conducted by different lecturers using different approaches indicate that the impact on the top half of the class is not significant whereas to the other half the approaches may have some bearing on the performance of the students.

Keywords: Thermodynamics, teaching approach, undergraduate teaching

Introduction

Thermodynamics is a basic science that deals with energy and has long been an essential part of the global engineering curricula. The standard approach to teaching thermodynamics at the university level has not changed significantly in decades. Material is introduced in lectures, which typically are expository and explanatory statements of concepts and applications. Homework assignments and exams are, in the main, skill tests requiring numerical or descriptive problem solving and factual recall. A glance at any of the many available thermodynamics texts reveals clearly the pervasiveness of the traditional approach. The flaws in the standard approach are both familiar and well documented. Students perceive it as boring and without purpose [1-2]. Furthermore, even after instruction, students retain significant misconceptions about many fundamental principles.

The recent revamp in Chemical Engineering curriculum saw the subject being taught in the first year before being introduced to energy balance where previously mass and energy balance was taught in the first year and thermodynamics was taught in the second year. This new arrangement makes teaching thermodynamics more challenging because the students are being introduced to an engineering subject for the first time in their course. It is thought that the way the lecturer conducts the lecture will have some effect on the performance of the students. This paper will discuss

the preliminary study on the outcome of two different approaches in teaching thermodynamics.

Methodology

For this preliminary study, two different lecturers who use different approaches were selected. These two lecturers taught different sections of the first year chemical engineering students. Although they were taught by different lecturers, students of both sections used the same textbook, had the same test and examination.

Section A

On a number of occasions, at the beginning of the class, sweets were distributed to the students in an attempt to create a relaxed atmosphere. The lecture was conducted for the first half of the period detailing the theories involved and solved problems as illustration. The students have been told to read the subjects matter before the lecture and the students are encouraged to solve the problems at the end of the chapter after the lecture. In the second half of the period, volunteers would come up to the white board to solve problems. There would be discussions should other students have different approaches. This method could be considered as an active learning method.

Section B

The conventional method is being practiced. A normal lecture would be delivered in the whole period. The entire lecture is almost passive, with students spending

their class time simply transcribing the lecture. Students were required to hand in the homework after a chapter was finished.

At the end of the semester, students were required to evaluate their lecturer in terms of their teaching method, lecture delivery, assessment and lecturer-student relationship. The grades of the students were also compared for both sections.

Results and Discussion

By sheer coincidence, the number of students in each section for the subjects is the same, i.e. 54 students. The results of the student evaluations of their lecturer are shown in Table 1. For section A, utilizing half of the period for lecture and another half of the period for solving the problems on the white board, was given a low rating. Students seemed to prefer the lecture to be carried out throughout the period as indicated by the score in section B. However, for a brief lecture, the students are aware of the emphasis given to the important points whereas in section B, the perception that the lecturer has full grasp of the subject matter is more dominant.

For delivery, in Section A, due to the brief lecture and solving of problems on the white board will naturally limit the arrangement, inter-relation and expansion of the subject matter. However, the very nature of the method of solving the problems on the white board encourages interaction between the lecturer and students as indicated by the higher score. For section B, the score for giving suitable example and assignment is higher, but the score for using diverse technique is quite low. This is quite consistent with the conventional method of teaching. It is a consolation that the score for commitment is quite similar because the approach A could convey the perception of a lack of commitment on the part of the lecturer.

Both sections are required to take the same test and examination. For the assessment part, both sections score high rating for discussing the solutions of the examination question. The low rating for challenging assessment methods does not occur for section A because some students find that solving questions on the white board not only challenging but even daunting.

Students in both sections gave similar high and low scores for listening to students views/questions and accessibility to lecturer respectively but it could be argued that the fact that students want the lecturers to be more accessible may not be practical should they

assumed that lecturers should be available whenever needed. It is heartening that the lack of accessibility is not due to unfriendliness since both scores for open-mindedness and friendliness are relatively high.

Table 2 shows the performance of the students. There were 54 students in each section. With respect to the final examination results, for the top half of the class, the distribution of grades is quite similar. However, in section A all the students managed to pass and this could be due to the fact that students have to make an effort in order to be able to solve problems on the white board. Whereas in section B there may be lack of urgency among the lower half of the class and this cause failures.

Conclusion

Students should be more involved in their learning of thermodynamics and a more collaborative nature should be encouraged. Most students learn effectively in so called active learning environment and resulted in no failure. Therefore, the way the lecturer teaches does have a significant effect for some of the students especially for slow learner students.

Reference

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- [2] Gabel D, Improving Teaching and Learning through Chemistry Education Research: A Look to the Future, *J Chem Ed*, 76, 1999, 548-554

Table 1: Results of student evaluation. Scale 1 to 5 is used where 1,2,3,4 and 5 are very poor, poor, average, good and excellent respectively.

	Section A	Section B
Teaching		
1. Briefing of the subject at the beginning of the semester (objective, assessment etc.)	3.93	3.98
2. Lecturer's preparation for the lecture	3.71	4.08
3. The utilization of lecture time	3.43	4.44
4. Conclusion and emphasis of important points	4.21	4.16
5. Lecturer's grasp of subject matter	4.00	4.44
Delivery		
1. The lecture is clear and easy to understand	4.08	3.66
2. Suitable examples and assignments given	3.93	4.28
3. The use of diverse technique of delivery	3.93	3.54
4. Interaction between lecturer and students	4.29	4.00
5. Arrangement, interrelation and expansion of subject matter	3.69	4.02
6. Teaching activities to inculcate generic skills	3.86	3.72
7. Commitment in delivery of teaching	4.15	4.20
Assessment		
1. The implementation of assessment is fair	4.07	3.98
2. Assessment methods are challenging for the development of individual	4.14	3.76
3. The results of assessment is given in reasonable time	4.07	3.90
4. Solutions of the assessment are discussed	4.33	4.04
5. The lecturer uses the results of assessment to improve teaching	4.00	3.78
Lecturer-student relationship		
1. Easy access to the lecturer	3.62	3.74
2. The lecturer is ever willing to help	4.08	4.10
3. The lecturer is very concerned with students progress	4.00	4.00
4. The lecturer listens to the students views and questions	4.67	4.26
5. The lecturer is open-minded and friendly	4.58	4.12

Table 2: Final grade of the students in both sections

Grade	Section A	Section B
A and A-	26%	22%
B+, B, B-	39%	41%
C+, C, C-	26%	22%
D+, D	9%	7%
E (fail)	0%	4%
Withdraw	0%	4%